Effect of STEAM Education upon Academic Achievement, Creative Thinking and Curiosity of Primary Students

Synopsis

Submitted in the partial fulfilment for the requirement of

Doctor of Philosophy

In

Education

Submitted By

Khushboo Agrawal

Under the Supervision of

Prof. D. Vasanta Kumari

DEPARTMENT OF FOUNDATION OF ECUCATION, FACULTY OF EDUCATION

DAYALBAGH EDUCATIONAL INSTITUTE (DEEMED UNIVERSITY)

DAYALBAGH, AGRA -282005

2022

1.0.0 INTRODUCTION

Education as the backbone of a successful Life, gives knowledge, values, confidence and necessary skills to an individual beneficial for society. Traditional Education occurs in a well settled environment with an only purpose to pour knowledge by teaching student. Ordinarily, Traditional Education takes place in a school environment with students learning with so many individual differences, abilities, interest and attitudes in classrooms . All schools are designed in a set of curriculums, organizational models, design of the physical learning spaces (e.g. classrooms), student-teacher interactions, methods of assessment, class size, educational activities, and many more.

There are many Methods to learn the Skills through Educational Methodologies in ancient times. Afterwards, the Method of Education has transform on to focusing on Reading and Writing skills. But on the other hand, these methods are not competent enough for 21st century of Education. To enhance the Educational Skills Philosophers and Educators gave their ideas and theories to maintain the structure of Education. Hence New Educationists gave ideas and approaches to apply older theories in a practical manner for developing 21st century skills.

In the current scenario, Educationists focus on practical approaches of learning by transforming theoretical ideas to practical form by implementing different types of approaches and techniques, resulting in; students can learn practical knowledge from their childhood and gain more skills. Association of one with another subject develops good Memory, Higher Order Thinking, Analytical power, Interest and Technology demands inclusion of many subjects with creativity to bring about quality and excellence in learning.

For developing the Skills, Educationist gave an idea to integrate few subjects with each other. These Subjects include Science, Technology, Engineering, and Mathematics i.e. STEM. A new approach has been developed to educate students namely STEM Education. This approach is very useful in developing child knowledge and skills in a very easy manner with practical approach.

As the time passed, STEM Approach is also lagging behind in developing Artistic Skills of students. Now a new approach is knocking the door to develop the skills with integration of Art doing by STEM, namely STEAM i.e. Science, Technology, Engineering, Art and Mathematics. It is not just an acronym; it is an approach to develop multiple skills at a time.

STEM can be defined in Two ways, first the traditional trend, like its terminology S- T- E- M. it is an individual 'silos' of every subject which has its own aspects, theories and methods but inter connected with all subjects (American Association for the Advancement of Science (AAAS,1993), International Technology Education Association (ITEA 2000), National Council of Teachers of Mathematics (NCTM 1989) & National Academy of Engineering (NAE 2004).

Secondly, The Modern Trend, which helps to educate with integration of ART SUBJECTS with STEM education. It gives new techniques of teaching and learning practice when all subjects are purposefully integrated .in this trend use one field as a base field and another subject use as their part of the based field. (Sanders Mark 2009).

NCERT (2019) emphasized that "At the primary stage, Art should be integrated with all subject and used and approach for teaching and learning of different concepts." It has an important role to increase curiosity, imagination and sense of wonder in students.

DEFINING STEAM EDUATION-

STEAM Education is an educational paradigm, which provides new ways to transform theoretical approach to practical approach and create multiple ways to understand the concept. STEAM is most appropriate approach of learning. It provides a platform of interdisciplinary subjects, which are integrated. STEAM provides many practical ways of learning like "LEARNING BY HAPPINESS", "FUN WAY LEARNING", "LEARNING BY DOING". It also helps to understand the "ARTIFICIAL INTELLINGENCE (AI)" and "INTERNET OF THINGS (IOT)".

STEAM is most important approach of Education in the current era, which creates practical approaches for the Educators and the students, it develops creative ideas to teach the students in a fun learning way, which helps in retention for a longer period. STEAM develops 21st century skills in students.

"**STEAM is an educational approach to learning that uses Science, Technology, Engineering, the Arts and Mathematics as access point for guiding student Inquiry, Dialogue and Critical Thinking." (Riley Susan, January, 2020)**.

"Science & Technology, interpreted through Engineering & the Arts, all based in Mathematical elements." ™ [Yakman ,Georgette, 2008].

HISTORY OF STEAM EDUCATION

STEAM is a new term but the methodology of this is old. In ancient era, many of Educators, Philosophers and Psychologist applied their theories which is supported STEAM. In present era, the theory of Philosopher and Educator is used in a practical way to better understanding of the concept. practical knowledge is need of developing skills, so the new Educator transform older theories in present context.

Philosopher Socrates and Aristotle was the propounded of the concept of **"pursuit of the knowledge of highest good"** (Pluto,375 BC). it is the base of Education and still used as a conceptual foundation in all research institute. The concept of STEAM framework also emphasizes the knowledge with highest quality. Many other Philosophers and Educator's theory also gives support to the STEAM i.e. the first Educational **Philosopher Descartes's theory of learning** also believes the practical intelligence which is obtained through real life experiences. (Bell, E. T. ,1937). John Amos Comenius who was the father of modern philosophy defined that 'Education is a preparation for life (Comenius, 1947).' it explores the door of success by acquiring knowledge. He also believed that life itself was the study in Education, he was the founder of hands-on learning methods. He said that 'observation precedes analysis' (Comenius, 1947). He stated that the natural curiosity of the young needed to be exploited by allowing access to formal education for them as well. Herbert referred the disciplinary education by saying: "geography, mathematics, the natural sciences and history are combined (Herbert, 1947)." which provided the base for development of Science, Technology, Society movement for a long period. Froebel's concept gave a meaningful structure to education. He believed that the world is filled by object which influence the people and their desire; therefore, people know that objects are the part of life in every condition. This concept provides a prominent method of education including a formal recognition, survey and understanding of the correlation between objects in their element and all related influences. All these theories and concepts are directly correlates to the modern philosophies. Froebel emphasized the contextual learning because it was the only way to promote real understanding. John Dewey always emphasized the people to gain a functional literacy (Dewey, 1963). He developed the stage for purposeful interdisciplinary studies, Dewey was explained integration of subjects by the examples of social constructs which shows how the developed methods and theories can affect the basic components

of other fields (Dewey, 1963). This concept is a core for integrative education with the aim of sustainable knowledge.

According to Descartes, knowledge **is "conviction based on a reason so strong that it can never be shaken by a stronger reason" (Newman, 2010)**

STEAM EDUCATION IN INDIA

In October 2019, Madhya Pradesh is transitioning into STEAM as the first region in India. It is an impressive approach to prepare students for the next generation of the society. The state government has been decided to start the STEAM model in government schools. STEAM model is based on South Korean concept of learning it will help in improving the quality of education and will be beneficial for many number of students studying in 1.21 lakh government schools in the state of Madhya Pradesh.

"**An initiative by Dept. of School Education by the Govt. of MP with a vision for a state-wide focus on integrated approach to Science, Technology, Engineering, Art and Mathematics and to 'steamify' education by crafting the future with STEAM techniques and approach to ensure that our students are equipped with 21st century skills" Shirvastava, Anubha (2019).**

There are various institutions which worked on STEM Approach/ Education in India i.e. the NES-SVB Group of Institutions have set up India's first STEAM Research Lab in Mumbai. This lab is for children from grade K -12 at the NES International School. The main purpose is to facilitate and build the research attitude among the students in education. The school is organizing the STEAM Lab Facility for students from all over the country through special weekend batches, seminars, workshops & camps. "The education be it IB, ICSE or State Board should be tailored to suits the needs of students and we are striving to fill the gap. With focus on training and innovative methods we intend to create tomorrow's innovators. We aim to produce innovators, not bookworms" Dr. Varadarajan, R (2018). Many More Private Organizations have also setup the STEAM based Educational System i.e. STEM World School, Kolkata, S.T.E.A.M School, Mumbai, The Robo Wizards STEAM Education, Mumbai, NeoRobos Educational Institution, New Delhi etc.

STEAM Education needs a base of school subject, because It is a framework to develop skills in individuals and provide an easy way to learn subjects in interdisciplinary manner. Educators use this

approach to develop student's capability in a longer term and achieving short term goals. The short term goals can be seen in student's academic performance, which all students undergo during school life.

STEAM Education provide various ideas to explore and penetrate in to the concept of Education. It is also helpful to develop interest in academics. It can be a base of Innovation, Collaboration, Creative Thinking, Curiosity and other skills.

ACADEMIC ACHIEVEMENT –

Academic achievement is an extreme goal of Education. It develops the skills in a particular subject/ subjects. Students enhance their skills in learning subjects and give their best to gain the academic scores. It is a short term goal of students and teachers. it provides potential and confidence to the student to achieve the goals. There is no standardized tool to measure the Academic Achievement. It can only be measured by institutional examinations and continuous assessments, but in the current scenario, Academic Achievement is not able to fulfill the goals of skill development and Knowledge Retention because student focuses on rote learning. They usually forget the subject learnt after their examinations, as they learn them superficially using rote memory.

Joseph, Rwandema (2017) did A study of academic achievement of secondary school students in relation to their achievement motivation study habits and learning styles in Kigali City Rwanda reveled that Large number of students are getting below average score. distribution of academic achievement score is heterogeneous.

Kaur, Harvinder (2016) studied Academic achievement of high school students in mathematics in relation to their creativity learning styles and mathematical aptitude revealed that it has a positive relation to students' creativity learning styles and mathematical aptitude.

Kumar, Naveen (2016) studied Classroom morale and academic achievement of adolescent students in relation to their creativity and socio economic status revealed that classroom morale and academic achievement has negatively correlated but creativity and academic achievement has positively correlated

Reddy, Prathapa M, (2011) did A study of academic achievement of D. ED students in relation to self-efficacy emotional intelligence achievement motivation and other variables revealed that All variable of the study enhances the academic achievement of the student.

Educator can enhance Academic achievement by using the skill of present century. This new approach of learning is STEAM. It is being used by whole world to increase the learning ability of their students.

CREATIVE THINKING-

Creative thinking is an ability to create or invent new things, concepts, ideas, solution, etc. it is an essential skill of present century, which can transform Imaginary world into real world. Everyone has a skill of creative thinking with his specific area. It makes a unique way to solve new problems.

Creative thinking includes visual arts, writing skills, problem solving ability, perception for different views. It is a gateway of new era, an important part of our daily life because we face different types of situations every day; creative thinking provides a different perception to deal with our situation. It enhances our knowledge for developing something new or recreate old concept in a new manner. Outcome of creative thinking is always fruitful; because it gives new innovation. In School times, many students don't recognize their capacity of creative thinking because during this time student focuses upon their studies and academic achievements only but this achievement is temporary because student does not have any practical knowledge. So in present time educator focuses on learning by doing, which is a part of STEAM Education. To create a healthy and fruitful atmosphere in Education, Educators develops the new interdisciplinary methods and techniques through STEAM Education.

Only creative thinking is not an only key to achieve goals of students but also a path without to enhance the Academic achievement and Curiosity of the student. Academic Achievements, Creative Thinking and Curiosity of the student are the essential elements of effective education, which provide an excellent way of successful life.

Mednik (1964) said that "Creative Thinking consists of the forming new combination of associative elements into new combinations which either meet specific requirements or are in some way useful. The more mutually remote the elements of the new combination, the more creative the process or solution"

Torrance (1979) defined Creative Thinking as "The process of sensing gaps or disturbing or missing elements, forming ideas or hypotheses and communicating the results, possibly modifying and retesting the hypothesis."

Ainling Chena,Lei Dong a, Wei liu b, Xingsen li c, Tiemei Sao a, Jun Zhanga (2015) did a on the mechanism of improving creative thinking capacity based on Extenics revealed that Extencies can break the mind set and give a chance to enhance creative thinking.

Yadav, Reena (2015) did a study of Creative Thinking in Relation to Intelligence and Self- Concept of 10+2 Students revealed that positive relation among the variables.

Rajasekaran, K (2013) did the study on The role of left and right hemisphericity in influencing creative thinking intelligence and academic achievement of high school students revealed that significant differences among variables.

Prabha, Geeta (2010) did A study of creative thinking among senior secondary school students in relation to psychological factors and organizational climate and found that their psychological factors and organizational climate are positively correlated with creative thinking.

Carlos Carbonell-Carrera, Jose Luis Saorin, Damari Melian-Diaz and Jorge de la Torre-Cantero , (2019) ,did a study on Enhancing Creative Thinking in STEM with 3D CAD Modelling revealed that Creative thinking with 3D CAD Modelling is effective to enhance creative thinking.

Sagar, J Vidya, (2007) Creative thinking in relation to intelligence and academic achievement among primary school children revealed that the relationship among there is unpretentious.

CURIOSITY –

Curiosity is an innate trait of human being which encourage the process of gaining knowledge or accepting new ways of learning. It is the process of an exploration, investigation and learning. It is only way to fulfill information gap because if you are not curious to gain any certain -knowledge you never fulfill the information gap. Curiosity is co related with all aspect of human behavior.

Silvia and Kashdan (2018) defined curiosity as "the desire to recognize, seek out and prefer stimuli that are Outside of one's normal experience."

Curiosity gives a path to the students to understand to concepts and formation of learning. It also provides the way to discover new things in a new manner e.g. law of gravity is the best example of newton's curiosity. Curiosity is a contagious quality so it can be driven from to one student to another. it reflects with the gaining of knowledge and experience the new concepts of learning. STEAM Education always use an innovative and practical method for explaining the concepts. It believes every

child is unique and have a dynamic behavior that's why their curiosity is also unique. Understanding the theories and concepts is the basic requirement of 21st century to develop a strong base for a student by arousing the curiosity towards study is required.

Dahiya, Geeta (2010) did a study of curiosity, social behaviors, obedient tendency and school satisfaction of girls of various categories of higher secondary level revealed that there are no significant differences among the variables.

Chahar, M.S. (2011) studied the effect of Edusat on curiosity, linguistic ability and achievement of primary school learners revealed Edusat is positively effective to teach primary school learners.

Sharron, Abraham Juneman (2014) researched on the role of curiosity in making up digital content promotion cultural heritage and found the content and information which is showed on digital platform for promotion is helped to raise curiosity toward cultural heritage.

Rai Dona (2018) did a study on children's academic achievement and their curiosity revealed that no significant differences in children's academic achievement and their curiosity.

To fulfill the requirement of student STEAM Education, have an important role in the present era. Educators believe that STEAM can enhance the Academic achievement, Curiosity and ability of Creative thinking.

1.1.0 EMERGENCE OF THE PROBLEM-

The major role of Primary Education as suggested by famous Educationists and Psychologists are to keep children in a healthy and safe environment, leading to cognitive skills, social behavior and relationship with society. Teachers should be expert in providing current experiential knowledge through various art, drawing, role-play, music, puzzle and movement activities. Primary children should be trained as sensitive observers of nature and society around them. This observation makes them more flexible, fluent, communicative, novel, curious and creative. This was suggested many a times by our previous commissions and education policies like Kothari commission, NEP 1986 and NEP 2020. Universalization of Primary Education includes free text books, uniforms, free Education, Mid-day meal program, DIET Training, DPEP, Sarv Shiksha Abhiyaan [SSA], Kasturba Gandhi Vidhyalaya etc. to provide various opportunities for the alternative educational provisions for primary students. Even after

these programs primary student dropout rate is not reduced and they are not paying interest in their studies.

All these points in the researcher's mind generated the following research questions-

1. What strategies or techniques are to be applied by the teachers to create interest among primary students?
2. Is there any special approach to inculcate interdisciplinary thinking skills among primary students?
3. How STEAM Education approach will be effective in Academic Achievement of primary students?
4. How STEAM Education approach will be effective in Creative Thinking of primary students?
5. How STEAM Education approach will be effective in Curiosity of primary students?
6. Is there any effect on Genders while teaching Environmental Science through STEAM Education?

To find out answers of the above research questions the researcher decided the title of her topic as "Effect of STEAM Education upon Academic Achievement, Creative Thinking and Curiosity of Primary Students".

1.2.0 JUSTIFICATION OF THE PROBLEM

An increasing concern to raise the educational development of all students, new approaches, methods and techniques of teaching were initiated to enhance their cognitive skills. Many new approaches strategies or methodologies invented were mostly concerned to a particular method or discipline and they were less successful in developing a child in a holistic way. Holistic approach to teaching includes an integration of all the beneficial points of each Method or Approach or Strategy. Researches done in Education revealed many lacunae or gaps in the existing curricula and teaching approaches. New policy of education 2020 suggested to train children in such a way to enhance their thinking, reasoning and analyzing abilities through peer interaction, problem solving and experiential learning.

STEAM Education, a new approach to learning which was known as STEM Education initially, correlates and associates the subject we teach with Science, Technology, Engineering, Arts and Mathematics. This new approach is the need of the hour, as students now-a-days are becoming mere rote learners and are not able to transform their passive capabilities in to active ones. This STEAM Approach/Education was found fruitful to make the learners not only active but also Curious and Creative. The following researches were done in the field of STEAM Education.

Nam-Hwa Kang. (2019) did a review of the effect of integrated STEM or STEAM (Science, Technology, Engineering, Arts, and Mathematics) education in South Korea.Yilip Kim, Namje Park (2012) studied The Effect of STEAM Education on Elementary School Student's Creativity Improvement. SoonBeom Kwona, Dongsoo Namb, TaeWuk Leec ,(2011) did the study on The Effects of Convergence Education based STEAM on Elementary School Students' Creative Personality. Lachman Rechard (2018) wrote his views on STEAM not STEM: Why scientists need arts training. Aysun Ata-Aktürk and Ozlen Demircan did a review of Studies on STEM and STEAM Education in Early Childhood. Vovers Jessica, Silk Melissa and Wade-Leeuwen Bronwen, (2018) explained the difference between STEM and STEAM. Verónica A. Segarra, Barbara Natalizio, Cibele V. Falkenberg, Stephanie Pulford,and Raquell M. Holmes (2018) wrote an article on STEAM: Using the Arts to Train Well-Rounded and Creative Scientists. Cathérine Conradty, Sofoklis A. Sotiriou and Franz X. Bogner, (2020) wrote an article on How Creativity in STEAM Modules Intervenes with Self-Efficacy and Motivation.

Researches done in the STEAM Approach/ Education revealed that it was a recent concept which came in to existence in this century to create a holistic personality through Education. Most of the studies/articles on STEAM Education exhibit a dearth of studies in drawing out the effect of STEAM Education upon Academic Achievement, Creative Thinking and Curiosity of Primary Students. Most of the studies are about its theoretical aspects, the integrated or convergent approach of STEAM Education, its effects on personality and it dominance in concentrating upon the same subjects and precautions to maintain balance in all the subjects were highlighted. Thus these studies created some research gaps like, effects of STEAM Education upon curiosity, intelligence, reasoning, creativity, imagination etc. and there is a lacuna of studies about the effect of STsEAM Education at different levels of Education and among various disciplines/subjects of the curriculum. To fill the gaps in the existing research on STEAM Education. the researcher took the topic of the effect of STEAM Education upon Academic Achievement, Creative Thinking and Curiosity of Primary Students by applying STEAM Education lesson plans of Environmental Science taught to Primary Students.

STATEMENT OF THE PROBLEM-

"Effect of STEAM Education upon Academic Achievement, Creative Thinking and Curiosity of Primary Students".

1.3.0 DEFINITIONS OF THE TERM USED IN THE STUDY

STEAM

"Science & Technology, interpreted through Engineering & the Arts, all based in Mathematical elements." ™

Georgette Yakman(2008)

Operational Definition-STEAM is an integration of multiple subjects like Science, Technology, Engineering, Arts and Mathematics in teaching the concepts of Environmental Science to Primary Students.

EDUCATION

"Education is the process of living through a continuous reconstruction of experiences. It is the development of all those capacities in the individual which will enable him to control his environment and fulfill his possibilities."

John Dewey (1916)

Operational Definition -Education is the process for sustainable development of the student which develops cognitive, psychological, physical, social aspects of students. It helps to gain self-esteem, confidence, ability to diversity, creative thinking, problem solving ability and provide the esteem path of success.

ACADEMIC ACHIEVEMENT-

"Achievement is a performance in school or college on standardized series of education tests. The term is used more generally to describe performance in the subjects of the curriculum".

Cosmo Dictionary of Education (2005)

"Academic Achievement refers to what the students have learned or what skills the student has learned and it usually measured through assessment like standardized tests, performance assessments and portfolio assessment".

Santrock(2006)

Operational Definition- Academic Achievement is the performance of students in Environmental science taught by STEAM Education measured by the score of the Academic Achievement test.

CREATIVE THINKING

Creative Thinking is the capacity to generate many different kinds of ideas, manipulate ideas in unusual ways and make unconventional connection in order to out the novel possibilities that have the potential to elegantly meet a given purpose

D. Ramalingam (ASER Report -2020)

"Creative Thinking in thinking outside the box and bringing those thoughts of life in a visual auditory way or using taste, smell or texture."

Jennifer Garcia (2004)

Operational Definition - Creative Thinking is the ability of fluency, flexibility, originality and elaboration of new discovery and innovative ideas to achieve the academic goals through STEAM Education in the subject of Environmental science.

CURIOSITY

"Curiosity is the impulse towards better cognition."

William James (1899)

"Curiosity is a cognitive induced deprivation that arises from the perception of a gap in knowledge and understanding."

George Loewenstein (1994)

Operational Definition- Curiosity is the psychological element of student's nature which will enhance the interest in newly developed method of learning (STEAM Education) and give a chance to build their own innovations. it is also the required element to learn and understand the concept of Environmental Science based on STEAM Education.

PRIMARY STUDENTS

Children who are between the ages of 5 to 11 years old are expected to attend a primary educational institution, where they learn subjects and skills that set the foundation for the rest of their schooling.

Kimberley McGee (2018)

Operational Definition – Students studying in classes 1 to 5 with an expected age group of 5-11 are referred to as primary students to enhance their academic knowledge

1.4.0 OBJECTIVES TO THE STUDY

1. To prepare the lesson plans based on STEAM Education in Environmental Science for Primary Students.
2. To study the effect of STEAM Education in Environmental Science on Academic Achievement of Primary Students.
3. To study the effect of STEAM Education in Environmental Sciences on the Creative thinking of Primary Students
4. To study the effect of STEAM education in Environmental Sciences on the Curiosity of Primary Students.

1.5.0 HYPOTHESES OF THE STUDY

H_1 1 There will be a significant effect on STEAM Education in Environmental Science on the Academic Achievement of Primary Students.

H_1 2 There will be a significant effect on STEAM Education in Environmental Science on the Creative Thinking. of Primary Students.

H_1 3 There will be a significant effect on STEAM Education in Environmental Science on the Curiosity of Primary Students.

1.6.0 VARIABLES OF THE STUDY

Independent Variables STEAM Education in Environmental Science

Dependent Variables Academic Achievement, Creative Thinking and Curiosity

Control Variables Age of Students, Class and School.

1.7.0 DESIGN OF THE STUDY

Research design is a blue print of the research which provides a clear path to researcher to test hypothesis after that studying the relationship between dependent and independent variable and successfully to complete the objectives of the study. In the present study researcher will be applying Quasi-Experimental Research Method for the achievement of the objectives.

PROCEDURE OF THE STUDY

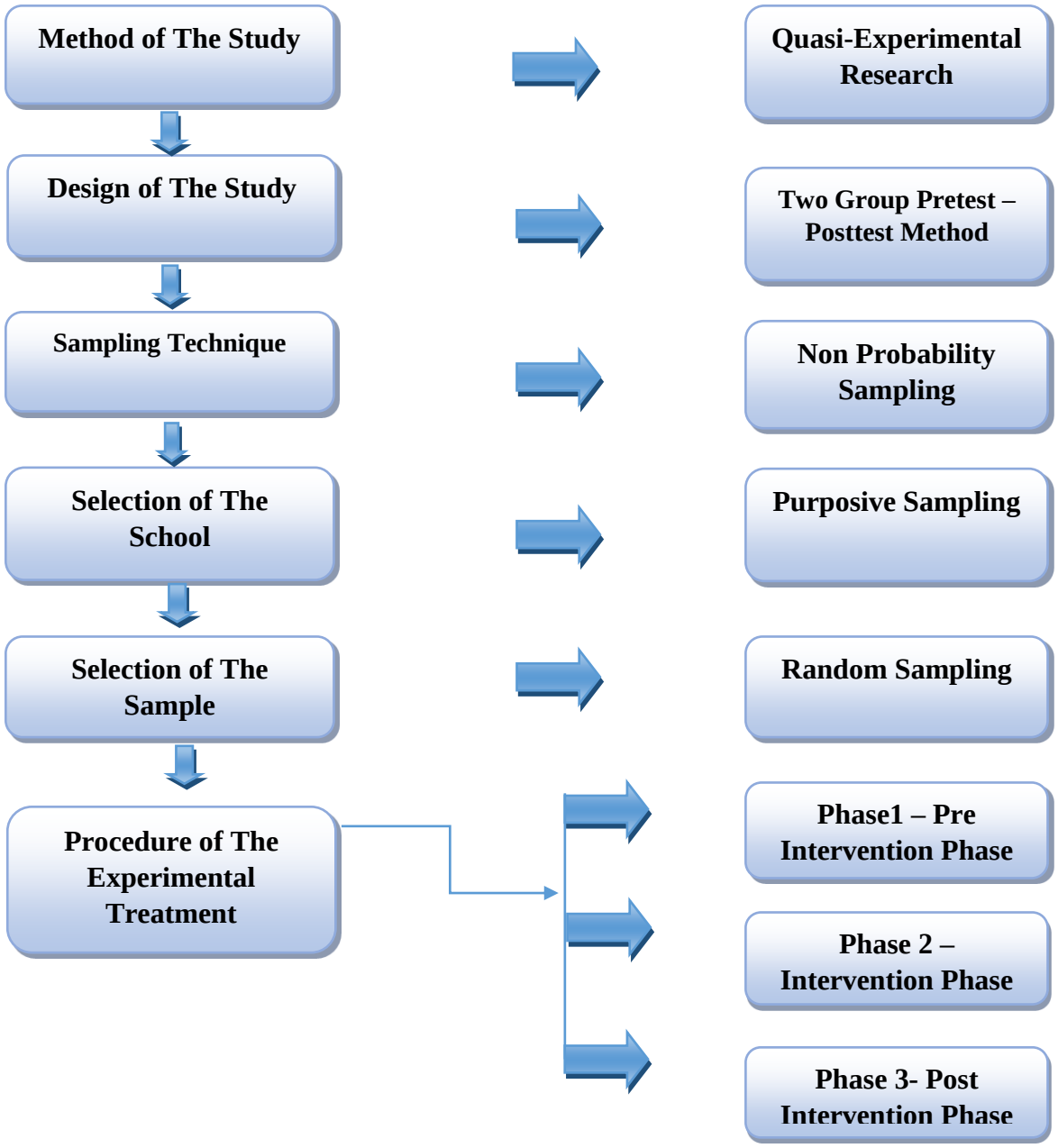

Fig. 1 Procedure of the study

The curricula of Environmental Science will be analyzed through Content analysis and some chapters will be selected from that curricula on which the researcher can apply STEAM approach of Education. Each Chapter will be further divided in to topics or lessons to be taught through STEAM approach i.e. to connect the content of that lesson with components of Science, Technology, Engineering, Art and Mathematics.

RESEARCH DESIGN OF THE STUDY

Table 1 Research Design of the study

GROUPS	PRE INTERVENTION PHASE	INTERVENTION PHASE	POST INTERVENTION PHASE
EXPERIMENTAL GROUP	Self-constructed Achievement Test Self –Constructed Tool of Creative Thinking. Children Curiosity Scale.	30 Lesson plans based on STEAM Educational approach will be taught to 40 Primary Students for 30 days. (40minutes per Period)	Self-Constructed Achievement Test Self –Constructed Tool of Creative Thinking. Children Curiosity scale.
CONTROL GROUP	Self-constructed Achievement Test Self –Constructed Tool of Creative Thinking. Children Curiosity Scale.	Lesson plans taught by using traditional methods of teaching will be taught to 40 Primary Students for 30 days. (40 minutes per Period)	Self-Constructed Achievement Test Self –Constructed Tool of Creative Thinking. Children Curiosity Scale.

1.8.0 SAMPLE OF THE STUDY

80 Primary Schools Students of Class Vth between an age group (9 -11), will be selected as sample.

SELECTION OF THE STUDENTS

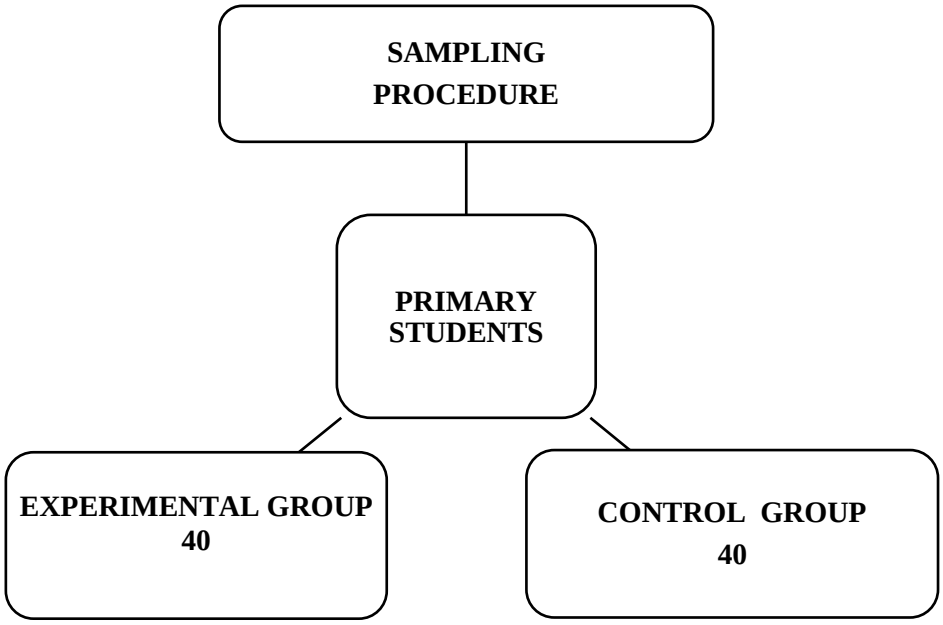

Fig. 2 Selection of the students

80 Primary School Students (40 Experimental group and 40 Control group) studying Environmental science will be selected from class Vth through Purposive Sampling Method.

1.9.0 RESEARCH TOOLS

1. Self-Constructed Tool of Academic Achievement Test.
2. Self –Constructed Tool of Creative Thinking.
3. Children's Curiosity Scale constructed by Rajeev Kumar (revised in 2009).

SURVEY TABLE OF CURIOSITY SCALE

Table 2 Survey table of curiosity scale

S.NO.	NAME OF THE TEST	AUTHOR	YEAR	NO. OF ITEMS	AGE/CLASS
1.	Self-Curiosity Attitude-Interest Scale (SCAI Scale)	Aschiri,F & Durosini,I	2015	51	18-65 years
2.	Curiosity and Exploration Inventory (CEI)	Kashdan, Rose & Fincham	2004	36	Graduation
3	"Curiosity and Exploration Inventory-II" (CEI-II)	Dr. Tod B. Kashdan	2009	10	Graduation
4	Five Dimensional Curiosity Scale (5DC)	Dr. Tod B. Kashdan.	2017	24	College Students
5.	Children's Curiosity Scale (CCS)	Dr. Rajiv Kumar.	2009	44	6 to 11 years

Hence the Researcher selected the Children's Curiosity Scale of Dr. Rajiv Kumar which is the most suitable one meant for Children of 6 to 11 years developed in1992 and revised in 2009 with 44 items. Questionnaires of Other variables will be developed by the researcher as most of the Questionnaires were old and meant for other age groups i. e. Secondary and graduate students. Their items do not justify the objectives the Research since our topic is focusing upon the application of STEAM Education approach on Environmental Science Teaching.

1.10.0 STATISTICAL TECHNIQUES

Statistics is most important component in experimental research. there are two types of research are used in Experimental research

1. Descriptive statistics
2. Inferential statistics

DESCRIPTIVE STATISTICS – It is used to describe the basic nature of the data to the study. In the present study Mean and Standard Deviation and' t' test will be applied to test the significance of the study.

INFERENTIAL STATISTICS – It provides the best suitable answer about the population and sample of the study. In the research graphical representation of data will be applied for testing the significance level of the data.

1.11.0 EDUCATION IMPLICATIONS

1. STEAM is the essential framework in present era. It emphasizes on providing a sustainable knowledge by integrating five major subjects by applying the various learning techniques and tools for students.
2. STEAM develops the capacity the problem solving ability. It is based on true experimental approaches.
3. STEAM is very useful to gain practical knowledge by enhancing the creative thinking of the students.

1.12.0 DELIMITATIONS

The present study will be delimited to following points:

1. Sample will be restricted to Agra City.
2. The present study will be delimited for primary school students of class V^{th}.
3. STEAM Education based lesson plans will be constructed in Environmental Science.
4. The Study will be delimited to 80 students.
5. The lesson plans of STEAM education will be Constructed for Hindi medium students.

REFERENCES -

1. Association of Advance of Science, (1993). Benchmarks for Science Literacy. Washington, DC.
2. American Association of Colleges for Teacher Education. (2007). Preparing STEM Teachers: The Key to Global Competitiveness. Washington D. C.
3. Ata-Aktürk, Aysun & Demircan, Ozlen. (2017). A Review of Studies on STEM and STEAM Education in Early Childhood. Journal of Kırşehir Education Faculty (JKEF). 18. 757-776.

4. Bell, E. T. (1937). Philosopher Descartes's theory of learning. Men of mathematics. New York:Simon & Schuster, Inc.
5. Conradty C, Sotiriou SA, Bogner FX, (2020). How Creativity in STEAM Modules Intervenes with Self-Efficacy and Motivation. Education Sciences. 10(3):70. https://doi.org/10.3390/educsci10030070
6. Staff. Ed. (2005). Cosmo Dictionary of Education. 416 pp, Cosmo Publications
7. Carbonell, Carlos & Saorín, José & Melian-Diaz, & Cantero, Jorge. (2019). Enhancing Creative Thinking in STEM with 3D CAD Modelling. Sustainability. 11. 6036. 10.3390/su11216036.
8. Chahar, M.S. (2011) studied the effect of Edusat on curiosity, linguistic ability and achievement of primary school learners.
9. Chena A. lai, D.A.,WEI.L.b. , Xingsen l.c ,tiemei .S.A & Jun Z (2015). The mechanism of improving creative thinking capacity based on Extenics. Procedia Computer Science, Volume 55, 2015, Pages 119-125,
10. Comenius A. J., (1947). R. Ulich (Ed.), Three thousand years of educational wisdom: Selections from great documents.
11. Dahiya, Geeta (2010). did a study of curiosity, social behaviors, obedient tendency and school satisfaction of girls of various categories of higher secondary level.
12. District Institute of Education and Training (DIET), (1988). http://www.educationforallinindia.com/page112.html
13. District Primary Education Program (DPEP),(1993-94). http://www.educationforallinindia.com/page91.html
14. Dr. Kothari D.S. (1964-66). The Education Commission.
15. Dr. Ramalingam (2020). Annual Status Of Education Report (ASER). Wave 1 –Rural, (www.asercentre.org)
16. Dewey john (1916). "Democracy and Education", A Penn State Electronic Classics Series Publication
17. Dr. Prasad, S.S and Dr. Rao, (2009). creative thinking of school student discovery publishing house Pvt. Ltd.

18. Dr. Varadarajan, R (2018). Founder President NES SVB group, Times of India
19. Ebel Robert L. (1966). "Measuring Educational Achievement", Prentice Hall of India Pvt. Ltd, New Delhi.
20. Froebel. (1947). R. Ulich (Ed.), Three thousand years of educational wisdom: Selections from great documents.
21. Garcia Jennifer (2004). Definition of Creativity, California State University, Northridge. http://www.csun.edu/~vcpsy00h/creativity/survey.htm.
22. International Technology Education Association (IETA), (2000).
23. Joseph, Rwandema, (2017). A study of academic achievement of secondary school students in relation to their achievement motivation study habits and learning styles in Kigali City Rwanda.
24. Kang, N. (2019). A review of the effect of integrated STEM or STEAM (science, technology, engineering, arts, and mathematics) education in South Korea. Asia Pac. Sci. Educ. 5, 6 https://doi.org/10.1186/s41029-019-0034-y
25. Kwon, S., Nam, D., & Lee, T. (2011). The Effects of Convergence Education based STEAM on Elementary School Students' Creative Personality.
26. Kaur, Harvinder, (2016). Academic achievement of high school students in mathematics in relation to their creativity learning styles and mathematical aptitude
27. Kumar, Naveen, (2016). Classroom morale and academic achievement of adolescent students in relation to their creativity and socio economic status.
28. Lanchand Richard (2018). STEAM not STEM: Why scientists need art training (theconversation.com)
29. Loewenstein G; (1994) The Psychology of Curiosity: A Review and Re-interpretation. Psychological Bulletin. 1994;116(1):75–98. [Google Scholar]
30. Mark, Senders, (2009) The Technology Teacher.
31. McGee Kimberley (2018) Definition of primary education, theclassroom.com
32. National Academy of Engineering (NAE 2004). https://www.nae.edu/25876/The-Engineer-of-2020-Visions-of-Engineering-in-the-New-Century
33. National Council of Teachers of Mathematics (NCTM), (1989). http://standards.nctm.org

34. National Educational policy, (1986). https://www.education.gov.in/sites/upload_files/mhrd/files/upload_document/npe.pdf
35. National Educational Policy, (2020). https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf
36. NCERT, (2019). ART integrated Guidelines.
37. Oxford dictionary of English third edition (2010), Oxford university press, great clarendon street, Oxford.
38. Prabha, Geeta, (2010). A study of creative thinking among senior secondary school students in relation to psychological factors and organizational climate.
39. Pluto (375 BC). "Pursuit of the knowledge of highest good", The Republic.
40. Rahmawati, Yuli & Sastrapraja, Achmad & Hadinugrahaningsih, T & Soeprijanto. (2019). Developing critical and creative thinking skills through STEAM integration in chemistry learning. Journal of Physics: Conference Series. 1156. 012033. 10.1088/1742-6596/1156/1/012033.
41. Rai, Dona (2018). A study on children's academic achievement and their curiosity.
42. Rajasekaran, K, (2013) The role of left and right hemisphericity in influencing creative thinking intelligence and academic achievement of high school students.
43. Reddy, Prathapa M, (2011). A study of academic achievement of D. ED students in relation to self-efficacy emotional intelligence achievement motivation and other variables
44. Riley Susan, January, (2020) Art integration specialist.;www.educationcloset.com.
45. Santrock J.W;(2006) Educational psychology (2nd edition). New delhi:Tata Mc.Graw-hill.
46. Sagar, J Vidya,(2007) Creative thinking in relation to intelligence and academic achievement among primary school children.
47. Sarv Shiksha Abhiyan (SSA), (2016) http://shikshaabhiyan.org.in/index.php
48. Sharron, Abraham Juneman (2014) researched on the role of curiosity in making up digital content promotion cultural heritage.
49. Segarra VA, Natalizio B, Falkenberg CV, Pulford S, Holmes RM, (2018).STEAM: Using the Arts to Train Well-Rounded and Creative Scientists. J Microbiol Biol Educ. Apr 27;19(1):19.1.53. doi: 10.1128/jmbe.v19i1.1360. PMID: 29904562; PMCID: PMC5969448.

50. Shirvastava, Anubha (2019).Deputy Secretary of Education .www.steamedu.com
51. Silvia and kashdan, (2018). positive psychology: the science of happiness & flourishing p.p. 119, sage publication
52. Simon, H; (1947) Administrative Behavior; A Study of Decision-Making Processes in Administrative Organisation ,259pp. Macmillan Company.
53. T.-h. Kim et al, (2012). (Eds.): SecTech/CA/CES-CUBE, CCIS 339, pp. 115–121,© Springer-Verlag Berlin Heidelberg, The Effect of STEAM Education on Elementary School Students Creativity Improvement .
54. Talks J. W; (1899). Teachers on Psychology: And to Students on Some of Life's Ideals. New York: Henry Holt & Company
55. Yakman, Georgette. (2008). STEAM Education: an overview of creating a model of integrative education.
56. Yadav, Reena, 2015, A Study of Creative Thinking in Relation to Intelligence and Self- Concept of 10+2 Students.
57. National Education Policy 2020. https://www.mhrd.gov.in/sites/upload_files/mhrd/files/nep/
58. NEP Final_English.pdf referred on 10/08/2020. National Education Policy 2020.https://www.mhrd.gov.in/sites/upload_files/mhrd/files/nep/NEP_Final_English.pd